

DOCUMENT RESUME

ED 057 006

SP 005 413

AUTHOR Owen, John D.  
TITLE The Determination of Teacher Salary and Quality: An Econometric Analysis.  
INSTITUTION Johns Hopkins Univ., Baltimore, Md. Center for the Study of Social Organization of Schools.  
SPONS AGENCY Office of Education (DHEW), Washington, D.C.  
PUB DATE Oct 71  
GRANT OEG-2-7-061610-0207  
NOTE 26p.; Report No. 117  
  
EDRS PRICE MF-\$0.65 HC-\$3.29  
DESCRIPTORS Public School Teachers; Statistical Analysis; Teacher Recruitment; \*Teacher Salaries; Teacher Selection; \*Teaching Quality

ABSTRACT

This paper applies the Carlsson-Robinson Theory of public employment wages to examine differences in salaries and quality of teachers using data from the Coleman Report. A modified Carlsson-Robinson model of quality determination is complemented with four testable hypotheses of salary determination. Teacher salaries were found to be determined by the level of per capita income in the systems employing them and by the salaries paid in competing occupations in the area. The local cost of living, the quality of the local labor force, and the quality of the teachers themselves were found to be statistically insignificant in determining differences in salary. The same analysis indicates that teacher quality is determined by the quality of the local labor supply and by the salaries offered to teachers. This result supports the view that school system officials do use their salary budgets to seek high-quality teachers and, moreover, that such teachers are attracted by those higher salaries. (Author)

ED0 57006

U.S. DEPARTMENT OF HEALTH,  
EDUCATION & WELFARE  
OFFICE OF EDUCATION  
THIS DOCUMENT HAS BEEN REPRO-  
DUCED EXACTLY AS RECEIVED FROM  
THE PERSON OR ORGANIZATION ORIG-  
INATING IT. POINTS OF VIEW OR OPIN-  
IONS STATED DO NOT NECESSARILY  
REPRESENT OFFICIAL OFFICE OF EDU-  
CATION POSITION OR POLICY.

THE DETERMINATION OF TEACHER SALARY AND QUALITY:

AN ECONOMETRIC ANALYSIS

Grant No. OEG-2-7-061610-0207

Project No. 61610-04

John D. Owen

Report No. 117

October, 1971

Published by the Center for Social Organization of Schools, supported in part as a research and development center by funds from the United States Office of Education, Department of Health, Education, and Welfare. The opinions expressed in this publication do not necessarily reflect the position or policy of the Office of Education, and no official endorsement by the Office of Education should be inferred.

The Johns Hopkins University

Baltimore, Maryland

SP005413

## INTRODUCTORY STATEMENT

The Center for Social Organization of Schools has two primary objectives: to develop a scientific knowledge of how schools affect their students, and to use this knowledge to develop better school practices and organization.

The Center works through five programs to achieve its objects. The Academic Games program has developed simulation games for use in the classroom. It is evaluating the effects of games on student learning and studying how games can improve interpersonal relations in the schools. The Social Accounts program is examining how a student's education affects his actual occupational attainment, and how education results in different vocational outcomes for blacks and whites. The Talents and Competencies program is studying the effects of educational experience on a wide range of human talents, competencies, and personal dispositions in order to formulate--and research--important educational goals other than traditional academic achievement. The School Organization program is currently concerned with the effects of student participation in social and educational decision-making, the structure of competition and cooperation, formal reward systems, effects of school quality, and the development of information systems for secondary schools. The Careers and Curricula program bases its work upon a theory of career development. It has developed a self-administered vocational guidance device to promote vocational development and to foster satisfying curricular decisions for high school, college, and adult populations.

This report, prepared by the School Organization Program, investigates differences in teachers' salaries and quality by applying the Carlsson and Robinson public employment wage theory to data from Equality of Educational Opportunity (the Coleman Report).

#### ACKNOWLEDGMENT

Helpful comments on an earlier draft of this paper were received from Barbara Bergman, Samuel Bowles, Barry Chiswick, James Coleman, John Holland, Christopher Jencks, Stephan Michaelson, Jacob Mincer and David Schwartzman. Computations were carried out by Mr. C. Stuart Goddin.

## INTRODUCTION

A recent paper by Carlsson and Robinson, "Towards a Public Employment Wage Theory," presented an analysis of how a public agency might rationally determine the optimum salary and quality of its employees.<sup>1</sup> The authors assume that the typical agency will have its salary budget fixed by a legislative body. They also assume that the agency will face a competitive labor market in which each quality of labor in an occupation will demand and get a separate wage rate. Carlsson and Robinson distinguish between two possible hiring situations: Model I, in which the agency can vary the number of its employees as well as their quality (perhaps substituting a larger number of lower quality people for a smaller number of more skilled people in, say, clerical positions), and Model II, in which the agency has a fixed requirement for a certain number of employees (the police force and the school system are given as examples of agencies in which substitution of personnel quality for numbers is difficult or impossible).

In Model I the greatest output will be achieved if the public agency compares the productivity and wage cost of applicants and tries to maximize the production of its services by obtaining the appropriate mix of quality and numbers. In Model II, maximum productivity will be obtained simply by using the salary appropriation to hire the highest quality staff possible.

---

<sup>1</sup>Robert J. Carlsson and James W. Robinson, "Toward a Public Employment Wage Theory," Industrial and Labor Relations Review, Vol. 22, No. 2 (January, 1969), pp. 243-248.

The Carlsson-Robinson theory can be used to shed some light on the causes of differences among American states and municipalities in public employee salaries and labor quality. Such an empirical analysis can be carried out most readily in the Model II situation, where the number of employees is given and quality is maximized, subject to a salary budget constraint. In this case, inter-community variations in salary budgets for a class of public employees will be the result of differences in the number of employees required and in the average salary that the community elects to pay.

Teachers today represent the largest single category of non-federal government employees. Moreover, they are a relatively good example of Carlsson-Robinson's Model II, as one teacher is conventionally assigned to each classroom, thereby creating a fixed requirement in number of teachers needed. An additional reason for selecting teachers for study is the considerable public concern in recent years both with teacher quality and salaries. This interest in the quality of teachers, of course, stems from doubt about the quality of the public schools and the continual debate over their success, or lack of it, in educating our children. The equally intense interest in teacher salaries is due to the large and rapidly growing fiscal burden they impose on the taxpayer.<sup>1</sup>

---

<sup>1</sup>An additional reason for selecting this occupational group was its relatively low level of unionism during the mid-1960's (the teacher quality data used here were collected during the 1964-1965 school year). See James A. Craft, "Towards a Public Employment Wage Theory: Comment," Industrial and Labor Relations Review, vol. 23, no. 1 (Oct., 1969), pp. 89-95, and Carlsson and Robinson, "Reply," Industrial and Labor Relations Review, vol. 23, no. 1 (Oct., 1969). See also Hirschel Kasper, "The Effects of Collective Bargaining on Teachers' Salaries," Industrial and Labor Relations Review, vol. 29 no. 1 (Oct., 1969), which provides an interesting empirical appraisal of the effects of union organization on teacher salaries.

An examination of the salary scale in the typical school system reveals that the Carlsson-Robinson model must be modified in one important respect if it is to be applied. In most school systems, hiring officials can not pay higher salaries to teachers of higher quality: they must conform to a rigid salary scale which bases pay differential almost entirely on length of service (most school systems provide a small additional premium for completion of a Master's degree). Recent research on teacher effectiveness suggests that other qualities, especially verbal ability, are more appropriate measures of teaching competence or quality than possession of a Master's degree or long-term teaching experience,<sup>1</sup> and there is some empirical evidence that school hiring officials are in agreement with this assessment.<sup>2</sup> However, because they are not usually permitted to pay a salary premium to a teacher who demonstrates superior verbal ability or shows other evidence of being an above-average teacher, a school system wishing to hire teachers of high quality can only set a high salary for all its teachers, rank applicants in terms of their quality, then hire them in descending order of ability until staffing requirements have been met.

This single-salary-scale restriction is not limited to the school system, of course, but extends to many categories of public employees. Its effects, however, may be more serious in the case of teachers, because school systems provide a major source of employment for the labor

---

<sup>1</sup>James S. Coleman, et al., Equality of Educational Opportunity, pp. 316-319.

<sup>2</sup>See pp. 10-13.

pool of female college graduates from which most school teachers are drawn. When the public employer is a small user of a particular grade of labor relative to the labor market in which it hires (for example, municipal employment of computer programmers), the single-salary-scale restriction need not lead to an important departure from the Carlsson-Robinson model: employees can then be drawn from a fairly homogeneous group, at the authorized, standard salary. However, when the public agency is a large employer in the market in which it hires, as in the case of teachers,<sup>1</sup> it must hire not only the best applicants but many others as well, of much lower quality, all at the same salary.<sup>2</sup>

Two conditions must be met for the Carlsson-Robinson model to be a useful tool: the hiring official must endeavor to obtain the highest quality employees possible, given constraints and the number of positions that must be filled, and higher quality personnel must be attracted by higher salaries. If applicants are simply accepted on a first-come, first-hired basis, or some other arbitrary condition is used,

---

<sup>1</sup>In the short run the situation is even worse because school systems will only hire graduates with the requisite courses in education. But even in the longer run, the potential supply of those preparing for teaching is limited by the total number of college graduates. See Martin Lapinsky, "A Study in Occupational Labor Supply Elasticities--The Labor Market for Teachers," Ph. D. Dissertation, The New School for Social Research, 1966.

<sup>2</sup>This would be expected to lead to the greatest inefficiency if the school system paid very high wages, hoping to attract applicants of very high quality. Such personnel are in relatively short supply and high ability generally commands a premium in the labor market, so that most employees hired would actually be very much overpaid. Alternatively, if the government is hiring in the middle ranges of ability, where there is a much denser concentration of potential employees in each ability rank (the more typical case in elementary school teaching), there will be much less overpayment.

or if higher quality personnel are not attracted by higher salaries, increased salary appropriations may not lead to increased staff quality. Written tests and interviews are in fact used to screen applicants for teaching positions in a large number of communities, indicating concern with the teacher's intelligence and ability to express herself. Furthermore, there is no reason to assume that teachers are any less responsive to financial inducements than doctors, nurses, or any other group. Nevertheless, the responsiveness of teacher quality to salary payments should be regarded as a hypothesis to be tested by the data, rather than as an assumption.

To this end, data on inter-community differences in the quality and salary levels of teachers might be examined for a possible correlation. However, differences in salary level itself may be influenced by the same factors which determine the average level of teacher quality, making any simple causal inference invalid.<sup>1</sup> For this reason, and because the determination of the wages of public employees is itself of intrinsic interest, the empirical analysis of teacher salary and quality will be more useful if the modified Carlsson-Robinson model of quality determination is complemented with testable hypotheses of salary determination. Four such hypotheses appear to be plausible and suitable for empirical investigation.<sup>2</sup>

---

<sup>1</sup>See pp. 13-14, for a further exposition of this point.

<sup>2</sup>These salary hypotheses are most helpful in understanding the relationship between salary and quality. For a somewhat different analysis designed to measure the net effect of unionism on teachers' wages, see Hirschel Kasper, op. cit.

1. Salaries of public employees will be higher where per capita income or wealth is higher. Even in the absence of a theory that argued that legislative bodies are concerned with the quality of public employees, one might hazard a guess that wealthy communities will pay higher salaries than others simply because there will be less resistance to higher expenditures where the community tax base is higher. However, the Carlsson-Robinson theory of quality determination affords an alternative explanation which is consistent with an explicit concern with quality: if the public demand for the quality of a service provided by government employees (education, law enforcement, and the like) is positively related to income, then--at least in the Model II case, where improvements in service must be made through improvements in personnel quality rather than through increased numbers--one would expect wealthy communities to strive to raise the quality of this service by paying higher salaries.

2. Salaries of public employees will be high if money wages are high in competing private employment. In such a case, whether or not a public agency is concerned about the quality of its employees, it may be forced by higher salaries in the private sector to raise its wages in order to fill positions. This effect will be most compelling when there are definite educational or other formal requirements for a government job, putting a lower limit on the quality of the applicants whom government can recruit, or when government is a major employer in an occupation, so that they can not recruit their staff en-

tirely from the lowest quality applicants among those who do meet the minimum formal requirements, but must instead pay an average wage closer to the median in private employment. Salaries of public employees may also be raised in response to increases in the private sector if government is explicitly concerned with quality of personnel: if a government is hiring and wishes to retain personnel of average or above average quality, rather than simply trying to minimize its salary costs, an increase in private wages will stimulate a competitive increase in the public sector.

3. Salaries of public employees may vary with the quality of the supply of labor available locally. If high-quality labor is scarce, one would expect that relatively higher salaries will have to be paid to obtain it. Unlike the first two hypotheses, this is not only consistent with, but requires an explicit concern with, quality in salary determination.

4. The cost of living could have an important independent effect on salaries in public employment if, for example, a paternalistic concern with the welfare and morale of public employees leads government to raise wages in response to increases in living costs.

These salary determination hypotheses appear to be applicable to the case of teachers. The fixing of the instructional budget in the typical American public school system is an outcome of the political process, so that Carlsson and Robinson's model of a "legislative body" determining salary budgets would seem to be appropriate. Within that

framework, the first and second hypotheses are the most plausible. One would expect wealthier communities to provide higher quality education for their children, and because teaching absorbs such a large proportion of the qualified labor supply, teaching salaries would be expected to be competitive with wages in private employment. The fourth hypothesis is also reasonable, although somewhat less plausible insofar as it relies on the concern of voters and legislators with the teachers' struggle to meet a high cost of living. The third hypothesis requires an explicit concern with teacher quality--for example, that salaries might be raised when a falling-off in quality in the local school system becomes apparent, as measured by a decline in the average teacher score on a standardized, written test--and hence assumes the highest degree of sophisticated rationality on the part of the "legislative body" involved.

The paternalistic, cost-of-living salary determination hypothesis is the simplest to examine empirically. An attempt was made to determine the relative importance of local variations in income (the first hypothesis) and in cost of living in determining salaries of teachers. Table 1 shows the results of the average level of regressing teachers' salaries in thirty-three metropolitan areas in which it was possible to estimate a local cost-of-living index on money income (see equation [1]) and on both money income and the local cost-of-living index (see equation [2]); teachers' salaries deflated by the cost-of-living index were then regressed on deflated money income (see equation [3]). These results clearly support the income but not the cost-of-living theory:

Table 1  
THE RELATIVE IMPORTANCE OF INCOME AND COST-OF-LIVING LEVELS IN  
DETERMINING SALARIES OF TEACHERS

| <u>Estimating Equation</u>                                | <u>R<sup>2</sup></u> |
|-----------------------------------------------------------|----------------------|
| (1) $S = 16.74 Y^{.645}$                                  | .59                  |
| t ratio (3.32) (6.6)                                      |                      |
| (2) $S = 6.49 Y^{.75} P^{-.34}$                           | .61                  |
| t ratio (1.72) (6.07) (1.37)                              |                      |
| (3) $\frac{S}{P} = 11.59 \left(\frac{Y}{P}\right)^{.687}$ | .45                  |
| t ratio (2.04) (5.0)                                      |                      |

Sources:

33 Metropolitan Areas

Y: Weighted Median Family Income:

Source: U.S. Department of Commerce, Bureau of the Census, 1960 Census of the Population, Volume I. Characteristics of the Population, Parts 2-52 (Washing., D.C., U.S. Government Printing Office, 1963) Table 76.

Note: State and local income weighted by percentage of Educational support from state and local sources.

S: SMSA Median Teacher Salaries:

Source: U.S. Department of Commerce, Bureau of the Census, 1960 Census of the Population, Volume 1, Characteristics of the Population, Parts 2-52 (Wash., D.C., U.S. Government Printing Office, 1963) Table 124.

P: Cost of Living Index

Source: Helen H. Lemale and Margaret S. Stoltz, "The Interim City Worker's Family Budget," Monthly Labor Review, Vol. 83, No. 8, August, 1960, pp. 785-808.

Note: Cost of living in cities added in 1966 estimated for earlier years by extrapolation of the average city family budget.

(a) the simple coefficient of determination between teachers' salaries and income is .59 (see equation [1]), more than four times the simple coefficient of determination between salary and the cost-of-living index, .14;<sup>1</sup> (b) when salary is regressed on income and the cost-of-living index (equation [2]), income is statistically insignificant and the cost-of-living index is not; (c) when real salary is regressed on real income (equation [3]), a much lower level of correlation is obtained. These statistical results imply that once community income per capita is taken into account, a study of local cost-of-living effects adds little to the explanation of teacher salary determination.

In order to test the other salary determination hypotheses and the hypothesis that systems use their salary budgets to improve the quality of their staff (the modified Carlsson-Robinson hypothesis), explicit quality data are required. Such data for a large national sample of schools were made available to the author; a special breakdown by state of the teacher salary and quality data collected for public elementary schools for the study Equality of Educational Opportunity (popularly known as the Coleman Report). Table 2 gives interstate correlations of per capita income and three measures of teacher quality: highest degree, experience and verbal ability. When teacher salary is correlated with these quality variables, rather similar results are obtained. The table indicates no relationship between the highest degree attained by teachers and either state income per capita or average teacher salary. The teacher experience results are even more striking. A strong negative relationship is found between experience and both salary and income. This

---

<sup>1</sup>Not shown as a separate regression.

Table 2

SIMPLE CORRELATIONS BETWEEN TEACHER VERBAL ABILITY, EXPERIENCE, AND  
EDUCATIONAL LEVEL AND TEACHER SALARY AND STATE PER CAPITA INCOME

| Measure of<br>Teacher Quality | <u>R<sup>2</sup></u>          |                   |
|-------------------------------|-------------------------------|-------------------|
|                               | State<br>Per Capita<br>Income | Teacher<br>Salary |
| Verbal Ability                | .61                           | .56               |
| Experience                    | .47*                          | .44*              |
| Highest Degree                | .01                           | .05               |

\*Negative relationship

Sources: Data on teacher verbal ability, experience, highest degree,  
and salary are from tapes for James S. Coleman, et al.,  
Equality of Educational Opportunity (aggregated by state).  
State per capita income from Survey of Current Business,  
Volume 48, No. 8, p. 15. Correlations obtained from data  
in logarithmic form.

negative relationship in the interstate analysis was confirmed by a study of variations of teacher experience in Illinois by county.<sup>1</sup> In the poorest districts of that state salaries are low and experience levels high;<sup>2</sup> in the richest districts the reverse is true. In general, experience levels are highest in those districts which lost population (usually rural districts or those characterized by a declining industrial base) and lowest in those which experienced the most rapid gains in population (often the more affluent suburbs).<sup>3</sup> These negative cross-sectional results support the hypothesis that the large, positive experience differentials in salaries observed within school systems reflect the internal bureaucratic needs of those systems, rather than their positive evaluation of the productivity of highly experienced teachers.

However, verbal ability is probably a better measure of teacher quality,<sup>4</sup> and Table 2 does show a high level of correlation between teacher verbal ability and both state income per capita and average teacher salary. The positive association between income and teacher salary and verbal ability observed in this inter-community comparison

---

<sup>1</sup>One of the very few states for which such data are available. See State of Illinois, Annual Statistical Report of the Superintendent of Public Instruction, State of Illinois (Illinois, Superintendent of Public Instruction, 1964).

<sup>2</sup>Examination of beginning salaries, average salaries paid, and salary scales all yielded similar results.

<sup>3</sup>In the national sample, the introduction of a regressor, percentage change in population showed that population growth was an important negative determinant of average teacher experience; however, a negative partial correlation of experience and income was still obtained.

<sup>4</sup>See page 3.

could be interpreted to mean that although the structure of the local salary scale (i.e., the dependence of salary increments on length of service) is designed to reward and retain older teachers or to serve other internal needs, the level of local teacher salaries is more responsive to market factors (such as the level of local per capita income and, possibly, the level of salaries in competing occupations or the quality of available personnel), while the level of teacher verbal ability is similarly responsive to differences in salary level.

The simple correlations with teacher verbal ability reported in Table 2 do not suffice to establish such relationships, of course. A common correlation of economic development with income, salaries and labor quality could also be used to explain these results. However, a simple statistical model can be used to test the various teacher salary and quality determination hypotheses, using these Coleman state data on teacher salary and verbal ability. If the level of teacher salary that school boards are willing to offer is a function of the per capita income of the area which they serve<sup>1</sup> and of the quality of teachers which can be obtained at that salary (hypotheses 1 and 3), then equation (1) below would be appropriate for statistical estimation. (Here,  $s$  is the level of teacher salaries,  $q$  is the level of teacher quality, and  $Y$  is per capita income in the area.) If the salary required by teachers is a function of their quality relative to the quality of the labor supply in the area where they are employed (the modified Carlsson-Robinson hypoth-

---

<sup>1</sup>Alternative measures of wealth were also employed in the regressions (based on the assessed and market value of property in the state). Rather similar results were obtained with these alternative measures.

esis of quality determination), equation (2) would be appropriate for estimation (where Q is a measure of the local quality of labor).

$$(1) \quad s = s_1(q, Y)$$

$$(2) \quad s = s_2(q, Q)$$

In order to estimate these models, empirical measures must be introduced that will serve as at least rough indexes of interstate variations in the quality of the labor force (q) and, in the alternative model, in the level of wages in occupations competitive with teaching (S). The quality of the labor force was indexed by the proportion passing the Armed Forces Qualifying Test in each state.<sup>1</sup> Lapinsky, in his national study of teachers, found salaries in the occupations in the group "managers, officials and proprietors" most useful in estimating the supply of teachers; a state index of those salaries was employed here.<sup>2</sup>

If the role of salaries in competing occupations (S) in determining teacher salaries (s) is also to be tested (the second hypothesis), the variable S can be added to the regression, as in equations (3) and (4). (This will be referred to as the alternative model):

$$(3) \quad s = s_1(q, Y)$$

$$(4) \quad s = s_4(q, Q, S)$$

The estimating equations (1) and (2) or (3) and (4) each contain two dependent or endogenous variables--teacher salary and teacher qual-

---

<sup>1</sup>The test data are for males, and most elementary school teachers are females. However, male and female scores are expected to be highly correlated.

<sup>2</sup>Martin Lapinsky, op. cit.

ity (s and q), so that estimation by the ordinary least squares method will yield biased, inconsistent results. However, consistent estimates can be obtained by the two state least squares method, in which the parameters of the two equations are estimated simultaneously.<sup>1</sup>

The results of these estimations are given in Table 3, along with estimates obtained by ordinary least squares, for comparison. For further comparison the table presents estimates obtained by regressing the jointly determined variables--teacher salary and teacher verbal ability--directly on the independent, exogenous variables--per capita income, quality of the local labor force, and salaries in competing occupations.

The results shown in Table 3 give little support to the view that salaries offered are determined by quality considerations. In both of the two-stage, least squares estimates (as well as in the ordinary least squares estimates) of the school boards' willingness to pay higher salaries (equations [1] and [3]), teacher quality is statistically insignificant. Moreover, when teacher salary is estimated directly as a function of the independent, exogenous variables, the quality of the local supply of labor is not statistically significant.

Other results shown in the table seem to be more promising: the estimates of the determination of the salary required by teachers appear to be reasonable (equations [2] and [4]), and, in the estimation of school board willingness to pay, much of the variation is explained

---

<sup>1</sup>In this estimation, q is first regressed on the independent or exogenous variables Y and Q (Y, Q, and S in the alternate model) by the ordinary least squares method. The estimates of q obtained in this fashion are then used as a proxy for the values of q in equations (1) and (2) ( (3) and (4) ) and these equations estimated by ordinary least squares. See C. F. Christ, Econometric Models and Methods, (New York: Wiley, 1966), pp. 432-446.

Table 3

## SIMULTANEOUS DETERMINATION OF TEACHER SALARY AND TEACHER QUALITY

Two-Stage Least Squares Estimates

|     |                                                                      | $R^2$ |
|-----|----------------------------------------------------------------------|-------|
| (1) | $s = 19.7 q^{.12} Y^{.70}$<br>t (9.06) (.61) (8.29)                  | .86   |
| (2) | $s = 0.1 q^{3.92} Q^{-1.32}$<br>t (4.85) (14.13) (9.18)              | .88   |
| (3) | $s = 19.9 q^{.07} Y^{.72}$<br>t (4.08) (.38) (8.48)                  | .86   |
| (4) | $s = .03 q^{1.97} Q^{-.60} S^{.62}$<br>t (3.39) (3.50) (2.58) (3.46) | .87   |

Ordinary Least Squares Estimates

|     |                                                                      |     |
|-----|----------------------------------------------------------------------|-----|
| (1) | $s = 19.7 q^{.11} Y^{.71}$<br>t (9.14) (.74) (10.32)                 | .86 |
| (2) | $s = 65.1 q^{1.40} Q^{-.09}$<br>t (3.75) (4.56) (.54)                | .56 |
| (3) | $s = 19.7 q^{.11} Y^{.71}$<br>t (9.14) (.74) (10.32)                 | .86 |
| (4) | $s = .16 q^{.43} Q^{-.012} S^{1.05}$<br>t (2.01) (2.05) (.13) (9.61) | .85 |

Table 3(continued)

Reduced Form Estimates

|                                     | <u>R<sup>2</sup></u> |
|-------------------------------------|----------------------|
| $s = 22.6 Y^{.73} Q^{.03}$          |                      |
| t (6.59) (13.01) (.31)              | .86                  |
| $q = 7.8 Y^{.18} Q^{.36}$           |                      |
| t (6.44) (4.89) (7.56)              | .82                  |
| $s = 3.94 Y^{.50} Q^{.06} S^{.40}$  |                      |
| t (1.24) (3.50) (.84) (1.74)        | .87                  |
| $q = 14.4 Y^{.27} Q^{.33} S^{-.14}$ |                      |
| t (3.52) (2.71) (6.97) (.90)        | .82                  |

Sources:

q: Teacher Verbal Ability  
Source: See Table 2

s: Teacher Salary  
Source: See Table 2

Y: State Per Capita Income  
Source: See Table 2

Q: Proportion in State Passing the A.F.Q.T. Mental Section:  
Source: U.S. Department of Health, Education, and Welfare,  
State Data and State Rankings (Washington, D.C., U.S. Govern-  
ment Printing Office, 1968), p. S-28.

S: Median Income of Manager, Officials, and Proprietors:  
Source: U.S. Department of Commerce, Bureau of the Census,  
1960 Census of the Population, Volume 1, Characteristics of the  
Population, Parts 2-52 (Washington, D.C., U.S. Government  
Printing Office, 1963), Table 124.

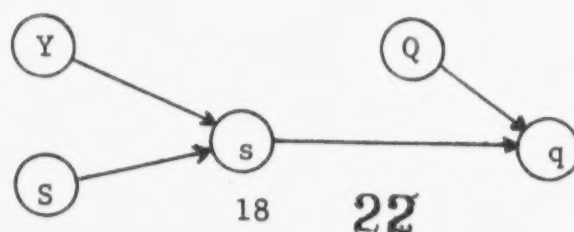
by differences in per capita income. However, since the results do not indicate that salaries offered to teachers are determined by quality considerations, it follows that the estimates reported in Table 2, which are based on the assumption that teacher salary and quality are jointly determined, are not reliable. The apparently positive results found there must then be investigated in another, more appropriate framework.

If salaries are determined by local school systems as a function of local per capita income, and, possibly of salaries in competing occupations, but are not responsive to local quality conditions (i.e., if the first and second hypotheses of salary determination are valid, but not the third:, equation (5) below would be suitable for the statistical estimation of teacher salary. If the quality of teachers the school system can hire is responsive to the level of salary offered, as well as to the quality of the local labor supply--the modified Carlsson-Robinson hypothesis of quality determination--then equation (6) would be appropriate for the statistical determination of teacher quality.

$$(5) \quad s = s_5(Y, S)$$

$$(6) \quad q = q(s, Q)$$

In this framework,  $q$  does not appear in the first equation, so that teacher salary and quality are not jointly determined. Rather, equations (5) and (6) might be regarded as a recursive system or "causal chain," in the sense that a line of causation runs from salary to quality, as in the schematic diagram below:



A recursive or causal chain system can be estimated by the ordinary least squares method.<sup>1</sup> Statistical results of this estimation are given in Table 4.

The results shown in the table strongly support the hypotheses underlying equations (5) and (6): teachers' salaries<sup>2</sup> are determined by community income and, to some extent, by salaries in competing occupations, and the quality of teachers hired is a function of salaries paid as well as of the quality of the local labor supply. Thus, the first and second hypotheses of salary determination and the modified Carlsson-Robinson model of quality determination are supported by this test.

### Conclusions

Public school teachers provide a good test of the Carlsson-Robinson model of the determination of the quality of public employees, and of several hypotheses of the determination of their salaries. Because teachers within each school system are paid according to a single salary scale, regardless of their quality, a modified version of the Carlsson-Robinson model must be used.

In an empirical analysis of cross-sectional data, teacher salaries were found to be determined by the level of per capita income in the systems employing them and by the salaries paid in competing occupations

---

<sup>1</sup>See Edmund Malinvald, Statistical Methods in Economics (Amsterdam: North Holland, 1966) and Herman Wold, Econometric Model Building (Amsterdam: North Holland, 1964) for useful discussion of the causal chain method.

<sup>2</sup>The salary figures used in the demand equations are state-wide averages. When sample salary data from the Coleman Report were fitted to these equations, very similar results were obtained.

Table 4  
THE DETERMINATION OF TEACHER SALARY AND QUALITY  
IN A CAUSAL CHAIN SYSTEM

|     |     |      |                  |                  | <u>R<sup>2</sup></u> |
|-----|-----|------|------------------|------------------|----------------------|
| (5) | s = | .42  | Y <sup>.43</sup> | S <sup>.69</sup> |                      |
|     | t   | .65  | 3.17             | 2.75             | .82                  |
| (6) | q = | 5.1  | s <sup>.21</sup> | Q <sup>.36</sup> |                      |
|     | t   | 3.79 | 4.56             | 8.08             | .81                  |

Source: See Table 3 and footnote 2, p. 19.

in the area. Thus the higher per capita income is in an area, the more willing its "legislative body" will be to pay high salaries to teachers and, in any event, as a large employer of labor, it will be forced to raise teacher salaries if salaries are high in competing private occupations. The local cost of living, the quality of the local labor force, and the quality of the teachers themselves were found to be statistically insignificant in determining differences in salary. Thus, no support is given to the hypothesis that legislative bodies paternalistically pay high wages to compensate for a high local cost of living, nor to the hypothesis that they are sufficiently sophisticated to adjust teacher salaries in response to changes in either the quality of their teaching staff or in the quality of the local labor supply. The same analysis indicates that teacher quality is determined by the quality of the local labor supply and by the salaries offered to teachers. This result supports the view that, although salary levels are not responsive to quality considerations, school system officials do use their salary budgets to seek high-quality teachers and, moreover, that such teachers are attracted by those higher salaries. Thus the modified Carlsson-Robinson model of quality determination is confirmed by the Coleman Report data examined here.

## REFERENCES

- Annual statistical report of the superintendent of public instruction.  
State of Illinois. Illinois: Superintendent of Public Instruction, 1964.
- Carlsson, R. J. & Robinson, J. W. Toward a public employment wage theory.  
Industrial and Labor Relations Review, 1969, 22(2), 243-248.
- Carlsson, R. J. & Robinson, J. W. Reply. Industrial and Labor Relations Review, 1969, 23(1).
- Christ, C. F. Econometric models and methods. New York: Wiley, 1966.
- Coleman, J. S., et al. Equality of educational opportunity. Washington, D. C.: Government Printing Office, 1966.
- Craft, J. A. Toward a public employment wage theory: Comment. Industrial and Labor Relations Review, 1969, 23(1), 89-95.
- Kasper, H. The effects of collective bargaining on teachers' salaries.  
Industrial and Labor Relations Review, 1969, 29(1).
- Lapinsky, M. A study in occupational labor supply elasticities - the labor market for teachers. Ph. D. Dissertation, The New School for Social Research, 1966.
- Malinvand, E. Statistical methods in economics. Amsterdam: North Holland, 1966.
- Wold, H. Econometric model building. Amsterdam: North Holland, 1964.